HYDROSTATIC RELEASE MECHANISM

Technical Field

This invention relates generally to the field of hydrostatic release mechanisms, and, more particularly, to hydrostatic release mechanism which is designed to sever a tether securing a floating device from a watercraft when the watercraft is submerged to a predetermined depth.

Background of the Invention

Floating devices such as emergency radio beacons or life rafts are normally secured to a watercraft by tethers when not in use. As is well known, such life rafts are designed for use by the crew of said watercraft in an emergency. However, when the crew finds itself in a rapid sinking situation caused by, for example, when the structural integrity of the watercraft is seriously compromised via a collision with another vessel or a reef, there may not be enough time to release all of the floating emergency equipment on a vessel. Other rapid sinking scenarios include, but are not limited to, explosions, fire, storms and the like. In such situations, the crew may find itself in the water with needed life rafts and emergency radio beacons still attached to the now submerged vessel.

There have been a number of mechanisms designed to alleviate this problem. For example, U.S. Patent No. 6,224,442 entitled "Release Unit" issued on May 1, 2001 to Simpson et al. discloses a device for releasing a link between a first object and a second object. The device comprises a body having a holding means for securing the body to the link; a releasing means for releasing the link; a pyrotechnic composition for actuating the releasing means; an igniting means for igniting the pyrotechnic composition, the igniting means being actuated by an increase in ambient pressure; and a pressure sensing means for detecting a change in ambient pressure. In one embodiment, the device can include a sliding blade actuatable by a pyrotechnic composition

that is ignited by an electrical stimulus activated by an increase in ambient pressure, and the link may be, for example, a cable securing an emergency radio beacon to a water craft. If the water craft becomes submerged, and the device is thereby exposed to an increase in ambient pressure, the electrical stimulus will be activated to ignite the pyrotechnic composition which, in turn, will actuate the sliding blade which then operates to cut the securing cable and release the EPIRB from the water craft. However, note the use of electrical stimulus to initiate the process.

U.S. Patent No. 5,365,873 entitled "Hydrostatic Pressure Sensors" which issued on November 22, 1994 to Wigram shows a hydrostatic pressure release for releasing a lift raft or the like when a ship sinks. A flexible diaphragm seals a chamber on one side and is exposed externally on its opposite side. A ceramic vent plug is mounted on the diaphragm so that it is protected within the casing of the device. The diaphragm has a resilient plate with an integral sleeve that projects through the collar in a rigid disc mounted on the plate. The plug is retained within the sleeve, in the collar. A rod projecting from the diaphragm extends into one end of an aperture in a slider and locks it in position. When the device is submerged, the diaphragm is deflected and pulls the rod out of the aperture allowing the slider to be released. A button on the slider extends into the other end of the aperture so that when it is depressed it pushes the rod out of the aperture and releases the slider.

U. S. Patent No. 5,177,317 entitled "Cable Cutter Assembly" which issued on January 5, 1993 to Walker et al. shows an explosive-type cable cutter assembly which includes a breech housing having a central passageway formed in it and a first slot extending from the exterior surface of the breech housing and opening into the passageway and a second slot extending from the exterior surface of the breech housing and opening into the passageway. The slots are each elongated in the direction of the central axis of the breech and each include a forward most edge and a rearward most edge. The cable cutting assembly also includes a threadable plug with an impact wall positioned forward of the slots and radial ports extending from the exterior surface of the breech housing into the passageway between the impact wall and the slots.

U.S. Patent No. 3,885,484 entitled "Explosively Actuated Compressed Disc Line Cutter" which issued on May 27, 1975 to Sturgis provides a cutting tool for use in severing lines and cables, especially those which are constructed from multi-filament, low denier polymer resins. As explosively activated piston drives a compressed disc through a segment of a multi-filament cable or line, thereby shearing a small segment thereof.

None of the known prior art disclose the combination set forth herein.

Summary of the Invention

It is an object of this invention to provide a hydrostatic release mechanism for releasing emergency equipment from a sinking vessel.

It is an further object of this invention to provide a release mechanism for emergency equipment which operates in response to ambient pressure change.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Brief Description of the Drawings

The present invention may be more readily described by reference to the accompanying drawings in which:

Fig. 1 is a perspective view of the present invention engaged with a tether;

Fig. 2 is an exploded side view of the invention; and

Fig. 3 is a top cross sectional view of the present invention.

Description of the Preferred Embodiment

Referring more particularly to the drawings by characters of reference, Figs. 1-3 disclose combinations of features which constitute the components of a hydrostatic release mechanism 10 of the present invention. Hydrostatic release mechanism 10 comprises a depth sensor 17 mounted to a sealed housing 12. In the illustrated embodiment, housing 12 comprises an upper portion 5 joined to a lower portion 6 by a plurality of bolts 7 thereby forming an interior volume 13. Those skilled in the art will recognize that other methods of joining are applicable to the present invention, including, but not limited to, ultrasonic welding.

A gasket 8 is captured between the peripheries of upper portion 5 and lower portion 6 to provide a seal between ambient conditions on the exterior of said housing and interior volume 13. Sealed housing 12 further provides a tunnel 16 extending through housing 12 which is adapted to receive a rope or tether 14 therein. Tunnel 16 is a continuous cylinder which is preferably integral with housing 12 but purposely thin and frangible by design. Housing 12 further includes a trigger 18 and a firing mechanism 20.

Those skilled in the art will recognize that while the present discussion relates to severing of rope or tether 14, the invention is applicable to use with other securing methods such as plastic cords or rods such as those used with emergency position indicating radio beacons (EPIRBs).

As shown, depth sensor 17 comprises a diaphragm 22 captured between a diaphragm cover 24 and a diaphragm frame 26. Diaphragm frame 26 defines an opening 27 between interior volume 13 and a small cavity 32 defined by diaphragm 22 and diaphragm cover 24..

In the presently preferred embodiment, diaphragm cover 24 and diaphragm 22 are secured to diaphragm frame 26 by six bolts 28 mounted to the periphery of frame 26, diaphragm 22 and diaphragm cover 24. Further, diaphragm cover 24 is provided with a plurality of passages 30 which provide liquid communication between the exterior of depth sensor 17 and small cavity 32.

When hydrostatic release mechanism 10 is submerged, water enters passages 30 and fills small cavity 32. As the depth increases, the hydrostatic pressure increases according to the well known formula (pressure = depth X water density).

The difference in pressure between the hydrostatic pressure from small cavity 32 on one side of diaphragm 22 to the sea level pressure contained on the other side of said diaphragm 22 maintained in interior volume 13 provides trigger mechanism 18 with means for actuating hydrostatic release mechanism 10. A trigger pin 40, a plunger 42 and a preloaded spring 44, in combination, hold diaphragm 22 in place until a predetermined trigger depth is reached. Preloaded spring 44 acts to prevent hydrostatic release mechanism 10 from accidentally triggering due to shock from drops and other rough handling. The trigger depth is predetermined by the characteristics of preloaded spring 44 wherein hydrostatic release mechanism 10 is actuated when the water pressure times the area of diaphragm 22 exceeds the outward force exerted by preloaded spring 44.

Firing mechanism 20 includes a latch 50 normally is restrained from rotational movement in the direction of arrow 52 by plunger 42. Latch 50 , via a small protuberance 51, restrains a hammer 54 from linear movement in the direction of arrow 56. However, once plunger 42 is pushed downward a sufficient distance by trigger pin 40, latch 50 is no longer restrained (note the offset of trigger pin 40) and moves in the direction of arrow 52. Hammer 54 then moves in the direction of arrow 56 at the urging of a firing spring 58 contained within firing spring cylinder 59. A pointed feature 60 of hammer 54 contacts a pyrotechnic cartridge 62 mounted at one end of a barrel 64 causing it to fire.

The expanding gases from pyrotechnic cartridge 62 are contained within barrel 64. A piston 66 mounted opposite pyrotechnic cartridge 62 moves in response to those expanding gases. A blade 68 is mounted on piston 66 opposite the pyrotechnic cartridge 62. The force of the expanding gases is transferred to blade 68 via piston 66 and blade 68 is guided to pass perpendicularly through the thin walls of tunnel 16 thereby severing any tether 14 contained therein. The severing of tether or rope 14 releases the attached emergency device to float to the surface as needed.

For safety, a blade barrier 70 is preferably positioned along one side of tunnel 16 opposite blade 68 to prevent blade 68 from puncturing through housing 12.

Although only certain embodiments have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.